IL-40-17

Illinois Institute of Natural Resources

State Geological Survey Division

Natural Resources Building
615 East Peabody Drive
Champaign, IL 61820

. ST. CLAIR CO.
E. ST. LOUIS/SCA-MILAM

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STATE OF ILLINOIS

August 19, 1981

Mr. Kenneth G. Mensing
Division of Land Pollution Control
Illinois Environmental Protection Agency
113 West Main Street
Collinsville, IL 62234

Dear Mr. Mensing:

This is in response to your request for a hydrogeologic evaluation of the East St. Louis/SCA-Milam landfill site in St. Clair County to supplement the hydrogeologic study the IEPA had conducted at the site. The legal description is given as the NW¼ NW¼ Section 4 and the N½ Section 5, T. 2 N., R. 9 W., St. Clair County. I apologize for the delay in answering your request; however, recent staff reductions and increases in requests for information have prevented an earlier response. I hope that the information supplied herein will be beneficial. This evaluation is based on the following sources of information: 1) the results of boring logs from subsurface studies at the site included with your request; 2) descriptions of subsurface investigations conducted in 1973 on file at the Geological Survey; 3) numerous letter reports from the Geological Survey providing preliminary hydrogeologic evaluations of proposed and existing waste disposal sites involving field inspections in the immediate vicinity of the subject site; 4)[redacted], of the hydrogeology of the subject site; and 5) a personal visit November 6, 1975, and extensive evaluation of the site with regard to possible inclusion in a study by the Geological Survey of the effects of waste disposal in the unsaturated zone. Enclosed are copies of correspondence from Survey files describing hydrogeologic conditions in the area and several diagrams illustrating, specifically, geologic conditions at the site.

The landfill site has reportedly been in operation for a number of years and accepts both general refuse and liquid/solid special wastes. The method of operation has been primarily by cut and fill with the trench method used for the special wastes. The approximate reported limit of landfilled area as of June 1981 is shown on figure 1. The older portion of the fill to the west of the creek reportedly extends only about 30 feet above ground surface while the fill to the east reportedly reaches 60 feet above ground surface. In 1978, a trench area in the northeast corner of the site was approved for disposal of special waste. Upon excavation ground water reportedly filled the trench below a depth of 5 feet and subsequent attempts to limit ground-water inflow were reported to be ineffectual. Disposal in the trench area was then suspended. Concern regarding possible contamination of ground water by the landfill is the basis for the current hydrogeological study.

The site is located in the Mississippi River flood plain northeast of East St. Louis, Illinois at an elevation, prior to filling, of approximately 400 to 410 feet above sea level.

KM
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The site is underlain by an average thickness of 120 feet of alluvium and glacial outwash. Test drilling indicates that fine-grained alluvium is present over a large portion of the site. Beneath the fine-grained alluvium is a substantial thickness of fine to medium sand which grades into coarse sand and gravel with depth.

To the west of the creek, test drilling in 1973 encountered up to 25 feet of older fill material consisting of alternating layers of refuse and compacted soil. Fine-grained alluvium, less than 10 feet thick, was encountered beneath the older fill at several locations; however, in some areas the entire thickness of fine-grained material was apparently removed prior to disposal resulting in disposal directly into the underlying sand. The enclosed letter reports describe hydrogeologic conditions in the vicinity of the landfill. The enclosed cross sections, A-A' and B-B', show the sequence of materials thought to exist beneath the site. It should be noted that the sandy clay encountered in boring 8 is not likely continuous beneath the fill but is probably a lense of material within the surrounding sand. This means that a significant portion of the refuse in the older fill area is probably in direct contact with the underlying permeable sand.

Test drilling indicates that fine-grained alluvium consisting primarily of clay underlies the entire area east of the creek. It is this area which was proposed in 1973 for development as an extension to the existing landfill. Clayey alluvium was encountered to depths of 9 to 24 feet. It was proposed that approximately 5 feet of clay would be excavated and stockpiled for use as cover material. [redacted] Fine to medium-grained sand directly underlies the alluvium. Cross section A-A' shows the sequence of materials beneath this portion of the site and the proposed base of the fill.

Large ground-water supplies have historically been obtained from wells finished in permeable sand and gravel deposits underlying the alluvium. Most of this water has been for industrial use. Until pumping was reportedly stopped in 1977 due to the availability of surface water, the site was located over a cone of depression created by heavy pumping in the National City area. An estimated 11.6 million gallons per day were withdrawn in this area in 1962. [redacted] Most municipal water supplies in the area are obtained from the Mississippi River.

Ground-water levels are very shallow beneath the site, generally less than 5 feet. In the permeable sand underlying the fine-grained alluvium ground water occurs under confined conditions. The existence of a ground-water mound is indicated by the higher water levels present within the older fill area. The data indicate that ground-water flow in the sand beneath the site is away from the site in virtually all directions--north, west and south and eventually toward the river to the west. In 1973, prior to the cessation of heavy pumping in the National City area, a horizontal gradient of 3 feet per mile was measured to the southwest. There are not sufficient data to accurately indicate the magnitude of the vertical component of ground-water flow; however, it appears that there is a predominantly downward gradient in the clayey alluvium and a primarily lateral component of flow in the underlying sand.

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Laboratory tests indicated that the hydraulic conductivity of the fine-grained alluvium varied from 1×10^{-7} to 9×10^{-9} cm/sec. The underlying fine to medium sand yielded values of 7×10^{-3} to 2×10^{-5} cm/sec. The hydraulic conductivity of the deeper sand and gravel aquifer was estimated by the State Water Survey to be about 1×10^{-2} cm/sec. Initial estimates of ground-water flow velocity beneath the site made in 1973 indicated that with an average hydraulic conductivity of 5×10^{-8} cm/sec, a vertical gradient of 0.086 ft/ft and a porosity of 50 percent, the velocity of vertical flow through the clay layer will be approximately 8.8×10^{-3} ft/yr. With a horizontal gradient of 0.0007 ft/ft across the clay, horizontal flow was estimated to be 7.4×10^{-5} ft/yr. However, it is not reasonable to use the measured total porosity to calculate the average linear ground-water velocity through a fine-grained material. It has been found that the effective porosity, the percent volume of interconnected pore space contributing to flow, is the proper parameter. The effective porosity of fine-grained alluvium is approximately 15 percent. Vertical gradients in fine-grained materials, also found to be somewhat greater than the initial estimate of 0.086, generally approach unity. The estimated value for hydraulic conductivity was also only an average. With these considerations calculations were made of ground-water velocity in the alluvium using a hydraulic conductivity of 1×10^{-7} cm/sec, an effective porosity of 0.15 and a vertical gradient of 1.0. The resulting estimated vertical velocity is .7 ft/yr. With the minimum estimated ~~thickness of 5.5 feet of clayey alluvium between the base of the fill and the underlying sand, an estimated 7.9 years would be required for ground water or a conservative solute to penetrate the clay. If interconnected lenses of more permeable material are present this time would be considerably less.~~

The ion exchange capacity of the clayey alluvium has been measured to be 36.1 to 43.5 meq/100 g dry soil. Initial estimates of the total potential exchange capacity of the clayey material also used average thicknesses of material and assumed that all the exchange capacity of the soil is available to the dissolved ions. Current research indicates that ion exchange capacity is not an accurate indicator of the total attenuation potential of soil.

There is concern regarding the adverse effects on ground water by the landfill. Ground water from several monitoring wells on the site has had significantly elevated concentrations of chloride, dissolved solids, boron, and several metals. Concentrations of chloride of 1400 mg/L have been measured in P-10 as compared to background levels of 10 gm/L from P-27. The susceptibility of the shallow sand aquifer to contamination and the long history of industrial development and waste disposal in this area, has resulted in widespread ground-water contamination. Substantial amounts of pollutants have originated from stockyards and local industries. It is frequently difficult to evaluate the effect of pollutants derived from a single source.

The enclosed figures were developed in an attempt to understand hydrogeological conditions beneath the site and to suggest possible reasons for the observed distribution of ground-water quality. Figure 1 is a map of the site with the locations of the borings and the locations of the cross sections. Figure 2 indicates the thickness of the upper clay alluvium prior to development of the area east of the creek. It should be noted that the clayey alluvium is absent in the southwest portion of the site and becomes thicker to the northeast. West of the creek, excavation prior to waste disposal was probably responsible for the removal of much of the clayey alluvium. It is evident that a portion of the older fill is in direct contact with the underlying sand. Several borings west and southwest of the old fill area encountered clayey silt which is more permeable and less uniform than the clayey alluvium to the northeast. Because the proposed base of the landfill east of the creek was reported to be 400 feet in elevation, figure 3 was prepared to show the thickness of the upper clay alluvium below 400 feet in elevation and, therefore, the thickness of clay which would underlie the landfill. ~~Note that the central portion of the site has considerably less than 10 feet of clay if the base of the landfill is at 400 feet in elevation. This is also shown on cross section A-A'.~~ There is little or no information on the significance of the silty, more permeable materials reportedly encountered in the five additional borings in the central portion of the site.

~~The ground-water contamination indicated by samples from Fill appears to be traceable only to the landfill.~~ Ground-water flow beneath the northern part of the site is probably toward the canal along the north edge of the site especially if a ground-water mound is present within the fill. It has been shown that the potential exists for pollutant migration through the clayey alluvium into the underlying sand. It is likely, however, that the primary source of contamination is probably the older portion of the fill not underlain by clayey alluvium. It should be realized, however, that with the multitude of potential sources of contaminants in this area it is very difficult to ascertain exactly the source or the extent of contamination from a single source.

If you have any questions, please contact me and I will respond immediately. I apoligize again for the unavoidable delay in answering your initial request.

Very truly yours,

Thomas M. Johnson

Thomas M. Johnson
Assistant Geologist
Hydrogeology and Geophysics Section

Enclosures

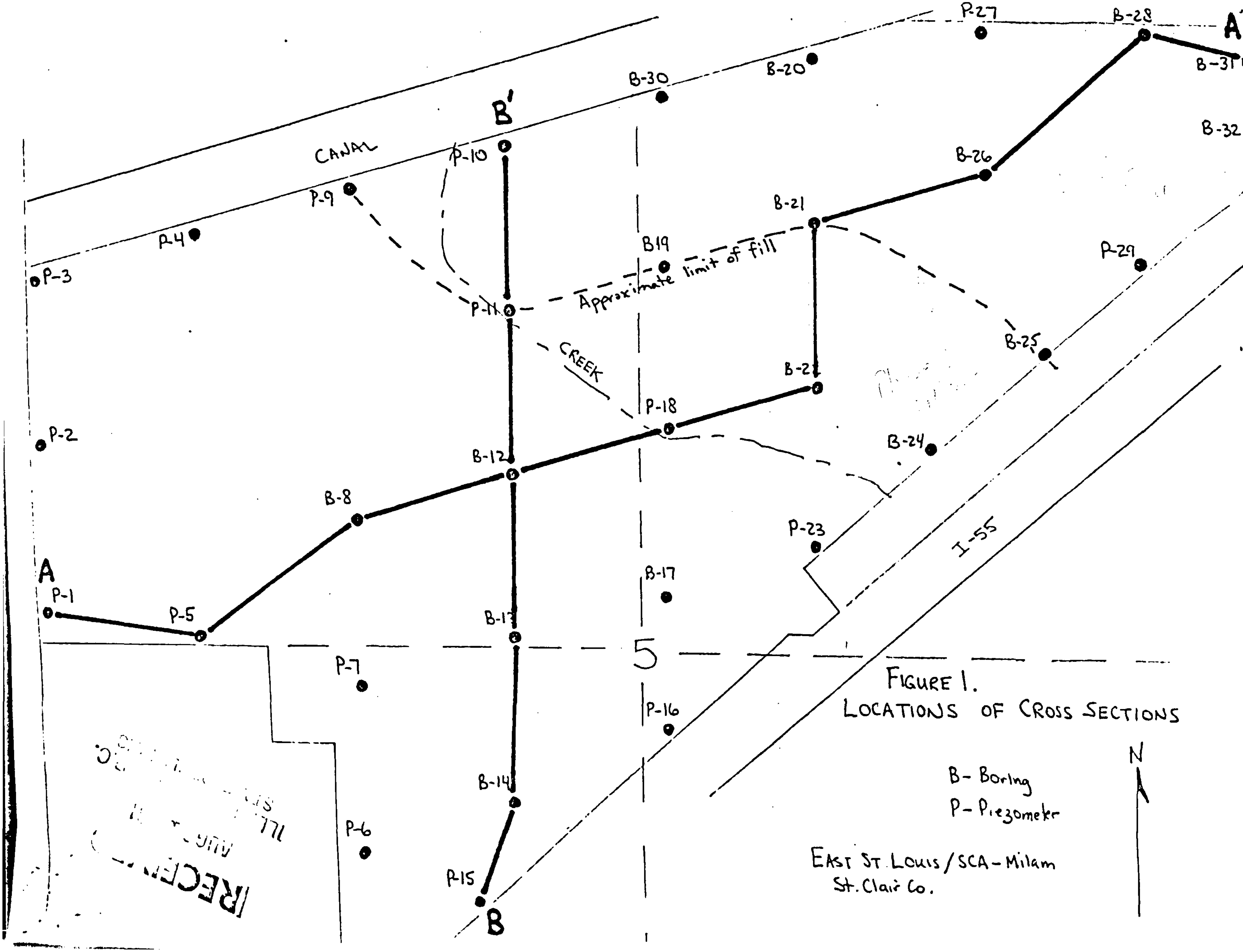

FIGURE 1.
LOCATIONS OF CROSS SECTIONS

B- Boring
P- Piezometer

EAST ST. LOUIS / SCA-Milam
St. Clair Co.

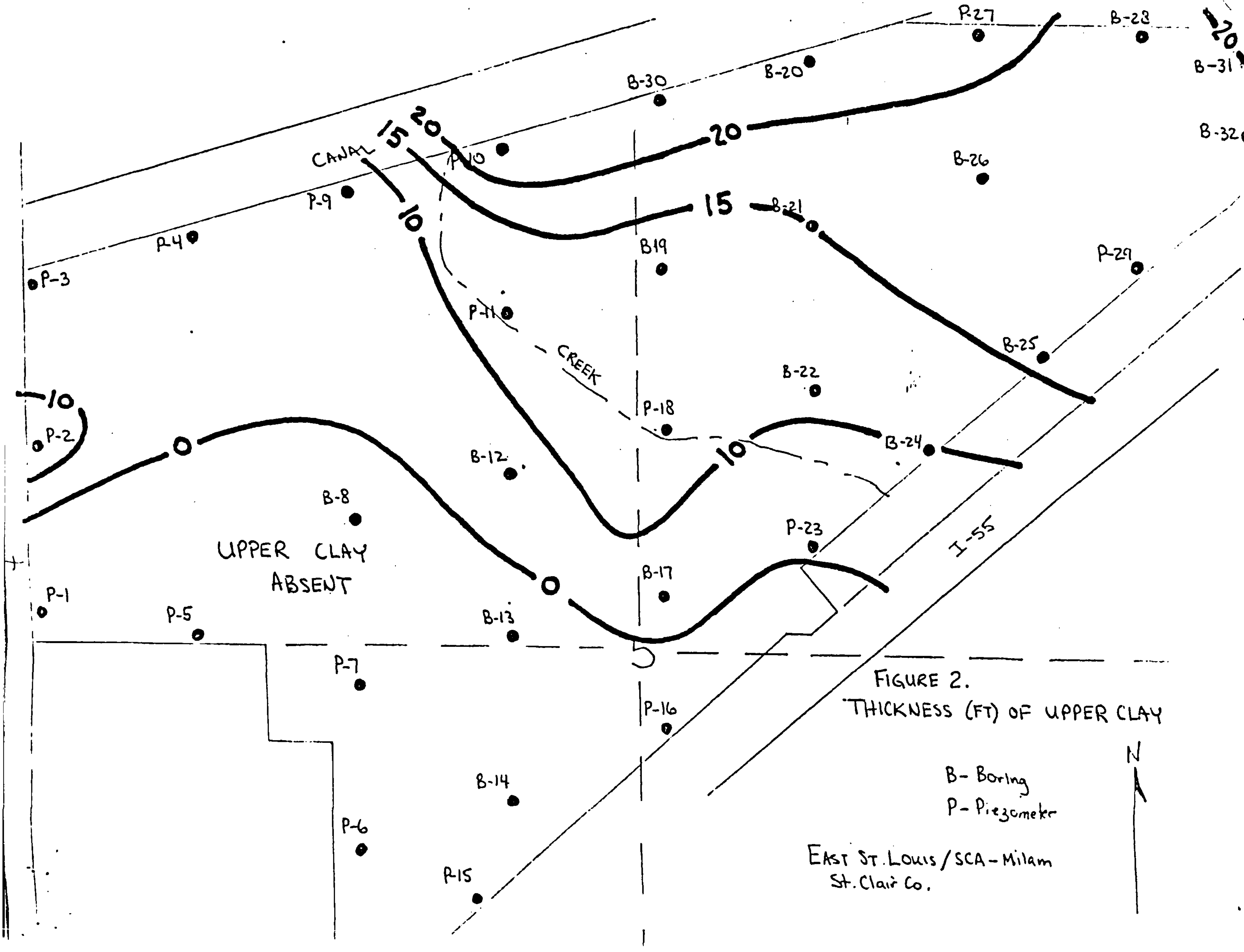

FIGURE 2.
THICKNESS (FT) OF UPPER CLAY

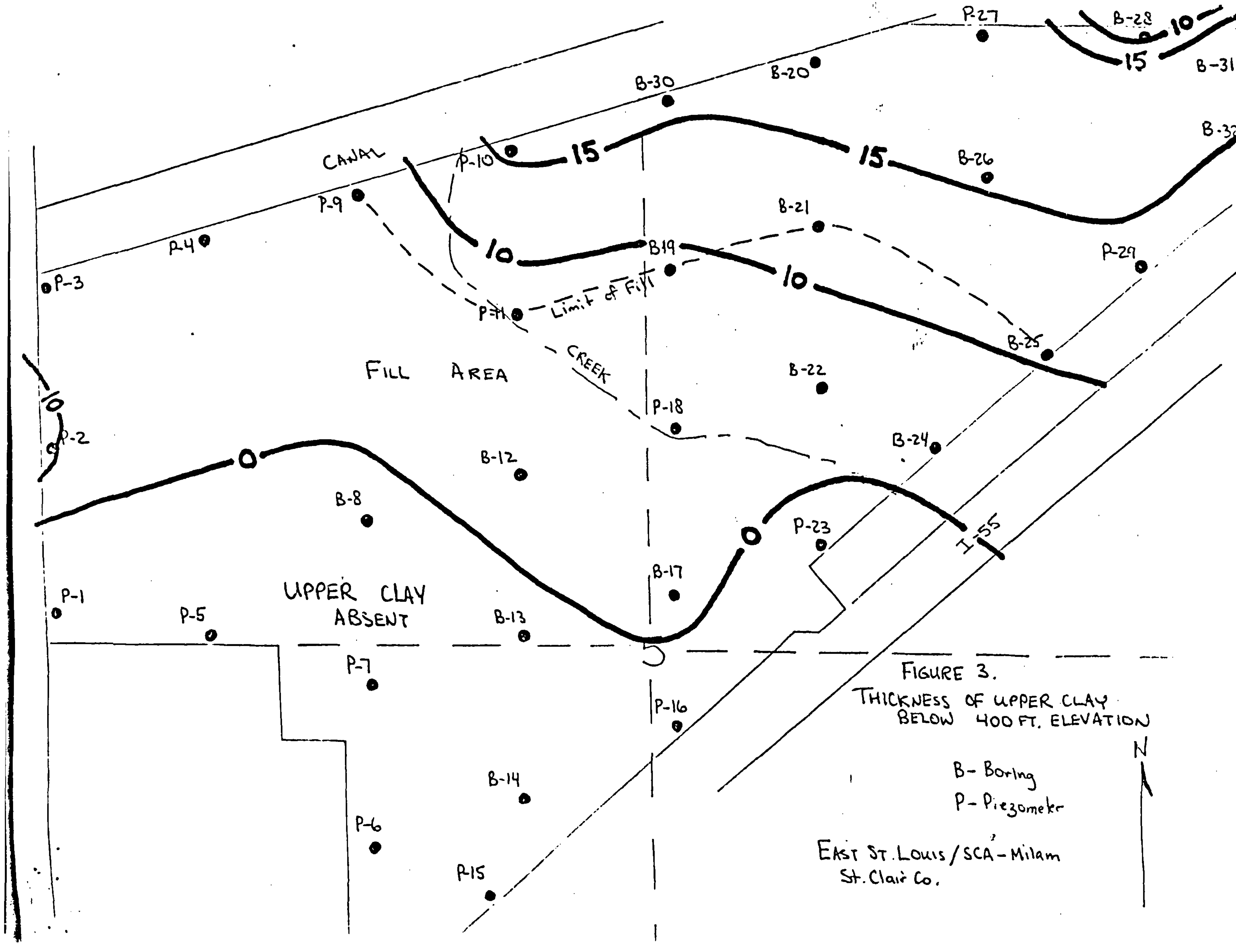

FIGURE 3.
THICKNESS OF UPPER CLAY
BELOW 400 FT. ELEVATION

EAST ST. LOUIS / SCA - Milam
St. Clair Co.

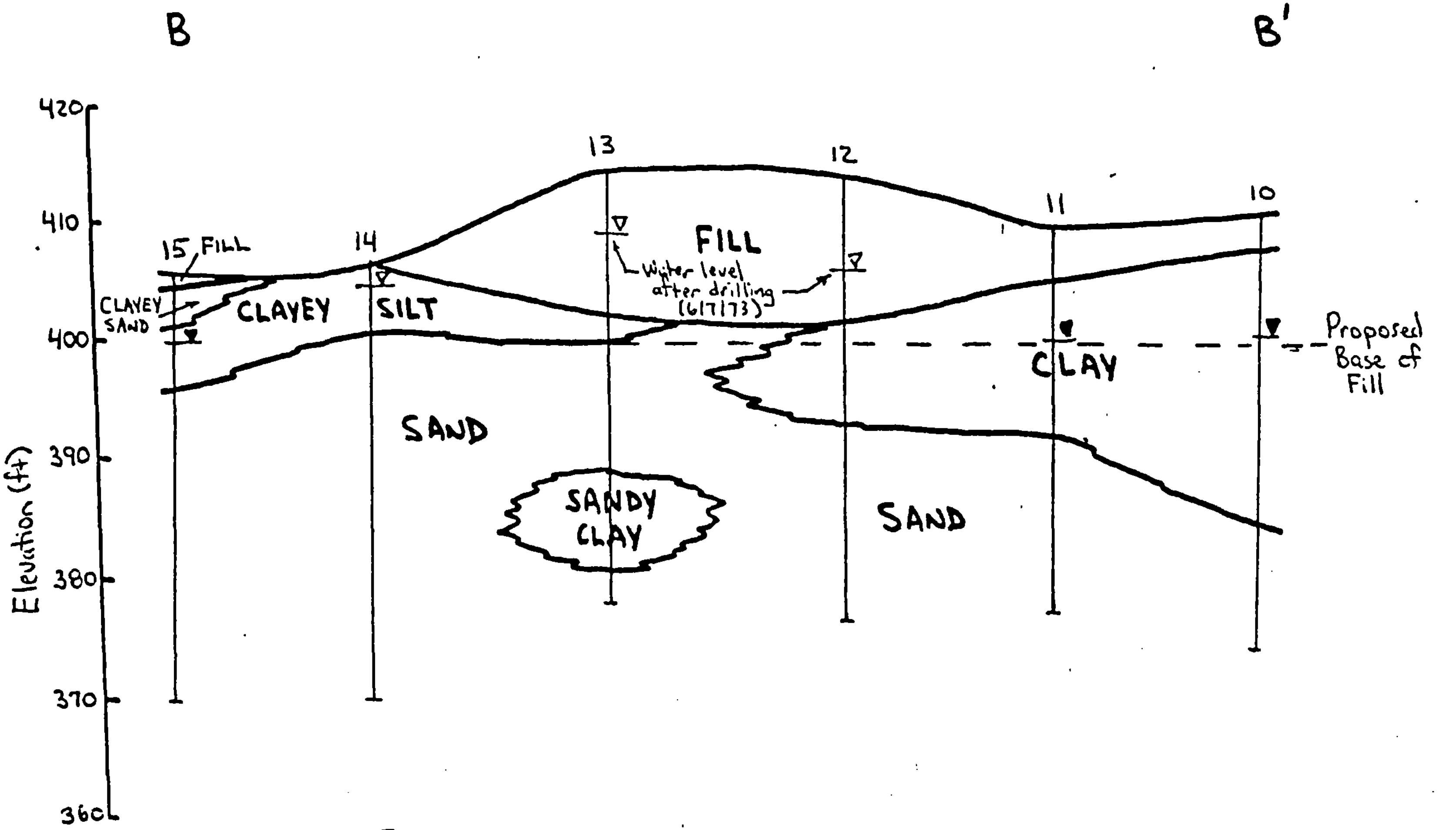

FIGURE 4.

Schematic north-south cross section of SCA-Milam landfill site, St. Clair Co.

(T. Johnson, Il. St. Geol. Survey, 6/4/81)

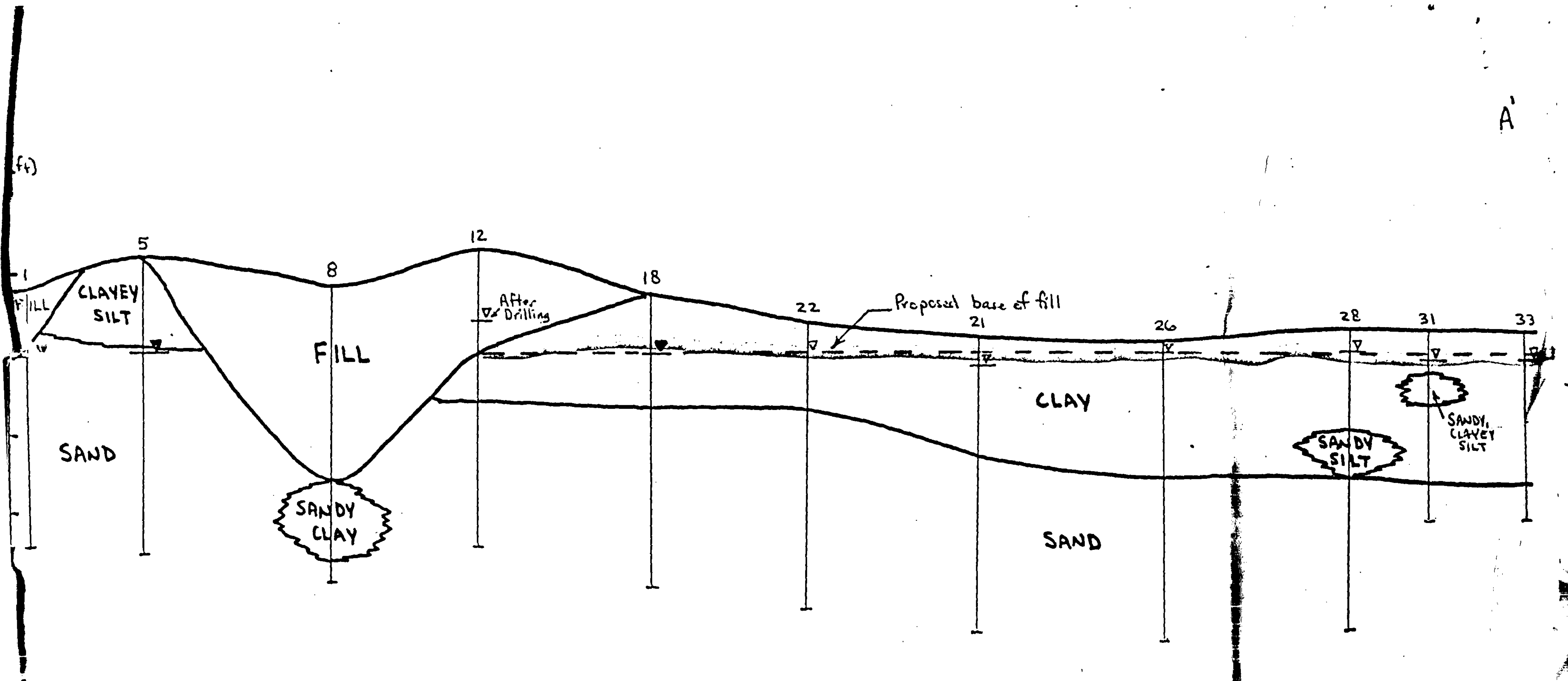

FIGURE 5. Schematic SW-NE cross section of East St. Louis / SCA-Milam landfill, St. Clair Co.
(T. Johnson, IL. St. Geol. Survey, 6/4/81)